The Effects of Trap Fishing in Coralline Habitats: What Do We Know? How Do We Learn More?

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ABSTRACT

Trap fishing in United States waters occurs in coral habitats in the Florida Keys, Puerto Rico, and the Virgin Islands. Although the numbers of traps fished and the general placement areas of traps are known, there is little information on the exact placement of traps by habitat type, seasonal movement of traps among habitats, and potential for gear impacts to various habitats such as seagrasses, macroalgae, sponges, and hard and soft corals. We are beginning to examine the placement of traps in relation to habitat types and, in the future, will be conducting underwater surveys of traps and fishing techniques in all three locales to determine potential for habitat damage and for gear or method modifications, if necessary.

KEYWORDS: Coral reef ecosystem, gear impacts, traps

INTRODUCTION

The effects of trap fishing on essential fish habitats, particularly coral reefs and reef-associated habitats, are largely unstudied. The U. S. Department of Commerce's NOAA Fisheries has identified traps as one of five types of fishing gear with the highest potential for impacting essential fish habitat (Hamilton 2000). Trap fishing occurs in coralline habitats under the jurisdiction of all three federal fishery management councils in the southeast U. S. and in state, territory, and commonwealth waters. Traps are used to capture spiny lobster *Panulirus argus* in Florida (Matthews and Williams 2000) and spiny lobster plus various reef fishes in Puerto Rico (Matos-Caraballo 2000a,b) and the U. S. Virgin Islands (Garrison et al. 1998).

We are building on preliminary investigations conducted in Puerto Rico (Appeldoorn et al. 2000) to compare and contrast the distribution and potential habitat effects of trap fishing in the Florida Keys, Puerto Rico, and the U.S. Virgin Islands. Our objectives are:

i) To review the known distributions of fishing effort and habitats and to suggest refinements,
ii) To develop methods for rapid, large scale surveys of the distribution of traps and potential for habitat damage in both shallow and deep waters, and

iii) To document gear effects on habitat and to suggest less destructive fishing methods, if needed.

WHAT WE KNOW

Florida Keys

The Florida Marine Research Institute (FMRI) employs a ticket system wherein fishers record a variety of data for each trip completed during the spiny lobster fishing season (August - March). Data include biomass landed, number of traps fished, soak times, coastal area, and whether traps were fished inshore / bay, offshore, or in federal waters. Landings generally are highest in August and decline through March. During 2000, most landings were recorded from the vicinities of the Dry Tortugas, Key West, and Marathon (83% of the 1.93 million kg total; NOAA Fisheries, Miami, FL, unpublished data). Approximately 20% of the total landings came from inshore or bay waters (mostly from the Florida Bay region near Marathon), while the remaining 80% came from offshore state and federal waters. Over 500,000 lobster traps were permitted for the 2000-2001 fishing season, approximately 90% of the traps were fished as singles, and traps were fished as deep as 45-60 m (T. Matthews, FMRI, Marathon, FL, pers. comm.).

Commercial fishers are requested to participate in an annual FMRI questionnaire that asks them to indicate on a map where they fished relative to a series of coastal markers (reefs, shallows, and lights differing from the aforementioned coastal areas) and how many traps they deployed each month. We used data collected after the 2000-2001 season to generate a finer-scale picture of the distribution of effort in relation to available habitat maps. Trap effort was expended on both Atlantic and Gulf of Mexico sides of the Florida Keys and the Dry Tortugas and extended along the southeastern mainland north of Biscayne Bay and Fowey Rocks (Figure 1). Effort was highest in the central Keys (particularly Bullard Light in the Gulf and Looe and Sombrero Keys in the Atlantic) and lowest at the extremes (northeast around Fowey Rocks, and southwest around Smith Shoal, Ellis Rock, and Cosgrove Shoal). There appeared to be little difference in proportional allocation of effort among areas between start (August 2000) and end (March 2001) of the fishing season, although the total number of traps in use decreased by 30%.

There have been several cooperative characterizations of south Florida benthic habitats (available from FMRI, St. Petersburg, FL, and NOAA, National Ocean Service, Silver Spring, MD). We have assembled these data in a geographical information system (GIS) format in order to overlay apparent fishing effort on habitat characteristics. Habitat categories have been combined to reflect three dominant features: coral reef, seagrass, and unknown or uninterpreted substrates due to poor water clarity (Figure 2). Corals are found primarily on the Atlantic side of the islands and around the Dry Tortugas and Marquesas. Seagrasses are the primary live bottom habitat inshore and are found in shallower waters inshore of reefs. Other live bottom and bare substrates (not pictured) are scattered throughout. Characterizations, however, have been depth-limited (< 30 m).

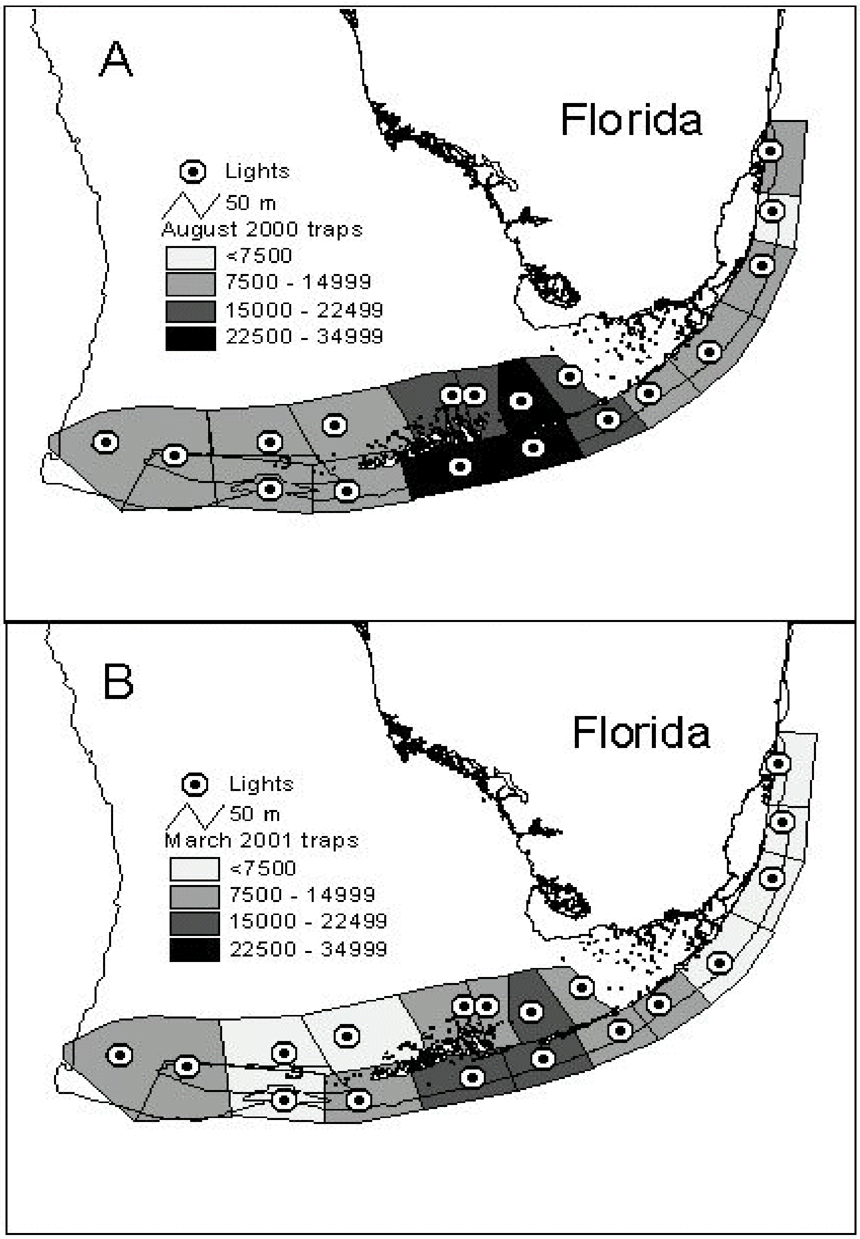

Figure 1. Distribution of lobster traps fished in 18 sections of the Florida Keys during August 2000 (A) and March 2001 (B). Lights refer to named shoals.

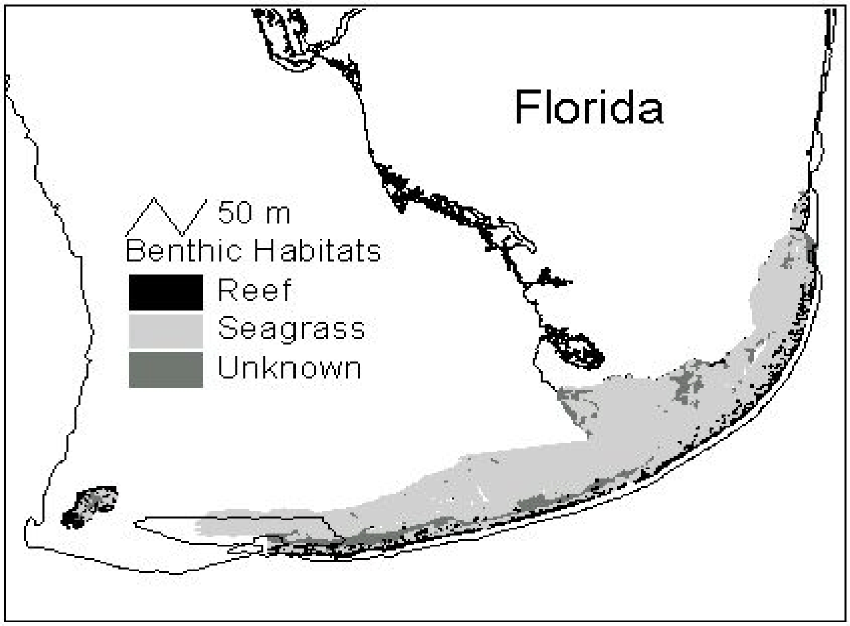

Figure 2. Dominant benthic habitats of the Florida Keys.

If we assume as a null hypothesis that fishing effort was spread evenly over all habitat types within each section of the coast, then we can get a first approximation of which habitat types could be impacted by trap fishing in each region. Most effort in inshore and bay waters appears to be placed in seagrass habitats, but offshore effort appears to have a high potential for being placed in coral habitats. Deeper water habitats have not been characterized, and thus there is some effort expended over unknown bottom types, presumably coralline in nature.

Puerto Rico

The Puerto Rico Department of Natural and Environmental Resources (PRDNER) employs a ticket system wherein fishers record a variety of data for each trip completed during the year (Matos-Caraballo 2000a). Data include species biomass landed, number of traps, hours fished, and municipality landing areas. Fish traps are employed in almost every municipality but are most numerous in the southwest (Cabo Rojo, Lajas), south central (Guayama), and east coasts (Culebra and Naguabo; 44% of the 11,213 total traps reported), whereas spiny lobster traps are almost all found on the east (Vieques and Culebra) and south (Juana Diaz; 52% of the 4,268 total traps reported; Matos-Caraballo 2000b). Trap fishery landings during 2000 included 223,000 kg of fish (primarily snappers, boxfish, grunts and groupers) and 50,700 kg of spiny lobster, and most landings were recorded from the aforementioned municipalities (Figure 3; NOAA Fisheries unpublished data). Examination of the distribution of traps and landings for 2000 indicates similar areas of concentration (Figure 3), however, there appeared to be under-reporting of traps in the southwest municipalities. Most traps are fished singly, at least in the southwest (Valdéz-Pizzini et al. 1997, Jean-Baptiste 1999, Appeldoorn et al. 2000).

Cooperative habitat characterization of shallow Puerto Rico benthic habitats by the University of Puerto Rico, PRDNER, and NOAA is still in progress (J. Christensen, U. S. Department of Commerce, NOAA, National Ocean Service, Silver Spring, MD, pers. comm.). Preliminary habitat data for the La Parguera (Lajas) area of southwestern Puerto Rico were available to estimate potential for habitat disturbance (Figure 4). Major habitat categories included coral reef, seagrass, bare sand or mud, and unknown or uninterpreted habitats. Corals dominate the offshore area, while seagrasses are primary in shallow inshore waters and around reefs. Bare substrates are scattered in the eastern section, and a large area of unknown habitat dominates the central section. Again, habitat characterizations have been depth-limited (< 30 m) and fishing may extend beyond these depths over unknown habitat types.

Assuming that fishing effort was spread evenly over all habitat types within the Lajas area, then the largest amount of effort would likely be placed in coral habitats. Preliminary observations by Appeldoorn et al. (2000) indicated that 57 of 100 traps were placed over or adjacent to coral. Given the position and extent of reefs, offshore effort occurring deeper than the mapped areas appears to have a high potential for being placed in coral habitats.

U. S. Virgin Islands

The Virgin Islands Department of Planning and Natural Resources (VIDPNR) employs a monthly log book wherein fishers record a variety of data for each day fished during the year. Data include biomass landed by major family groups (such as groupers, parrotfishes, or lobsters), number and type of traps fished, and area fished around each island. Landings vary by season, location, and species groups. During 1998 (the latest complete data set), fish trap landings were highest during January-March and lowest during May-June, whereas lobster trap landings were highest during January-February and lowest during July-August (NOAA Fisheries unpublished data). Landings for 1998 included 161,000 kg of fishes (dominated by parrotfishes, triggerfishes, and grunts) and 16,800 kg of spiny lobsters. Approximately 8,500 traps are permitted (1,500 in St. Croix and 7,000 in St. Thomas and St. John), with about half of the fishers using single traps and half using strings that may include hundreds of traps (B. Kojis, VIDPNR, St. Thomas, USVI, pers. comm.). Traps were most often placed off southwestern St. Croix and southern and western St. Thomas and St. John (Figure 5; NOAA Fisheries unpublished data).

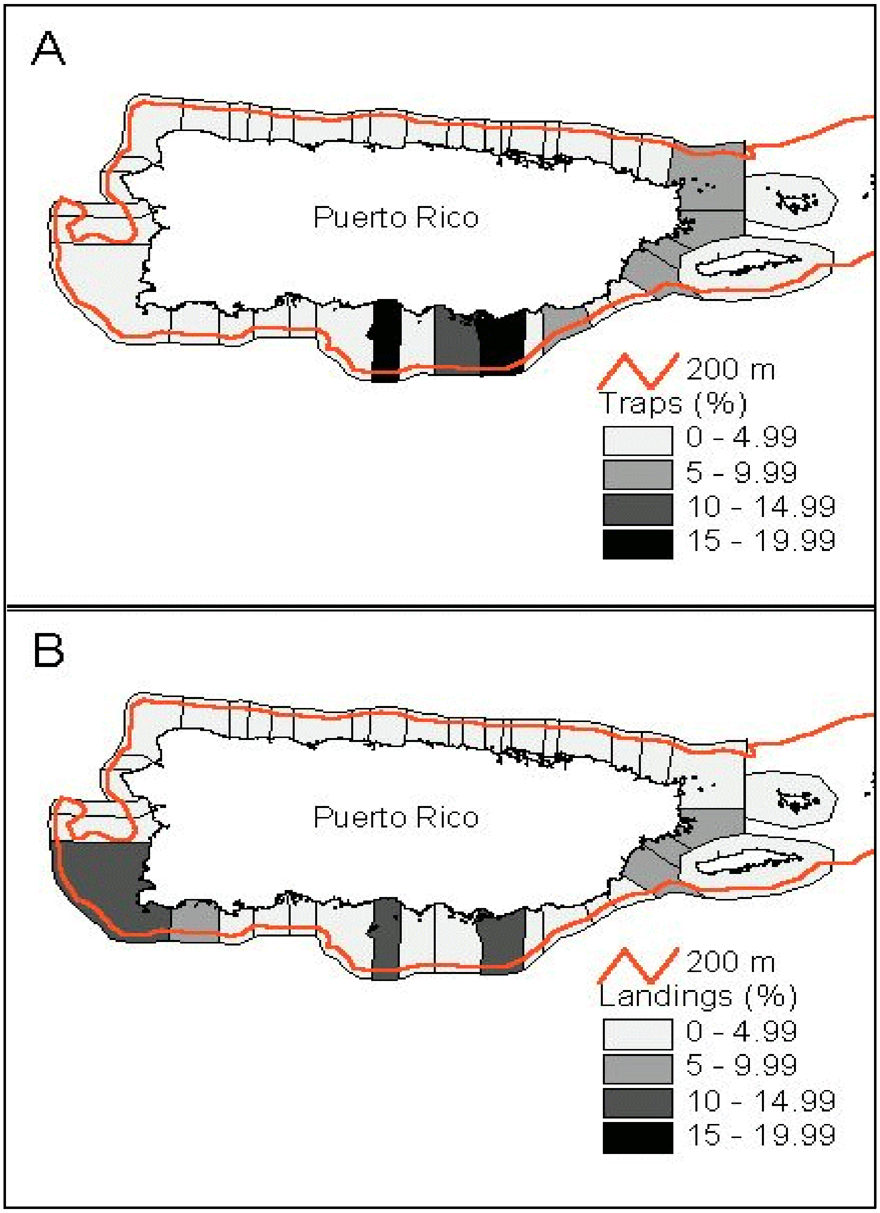

Figure 3. Proportional distribution of all traps fished (A) and all landings (B) off 42 municipalities in Puerto Rico during 2000.

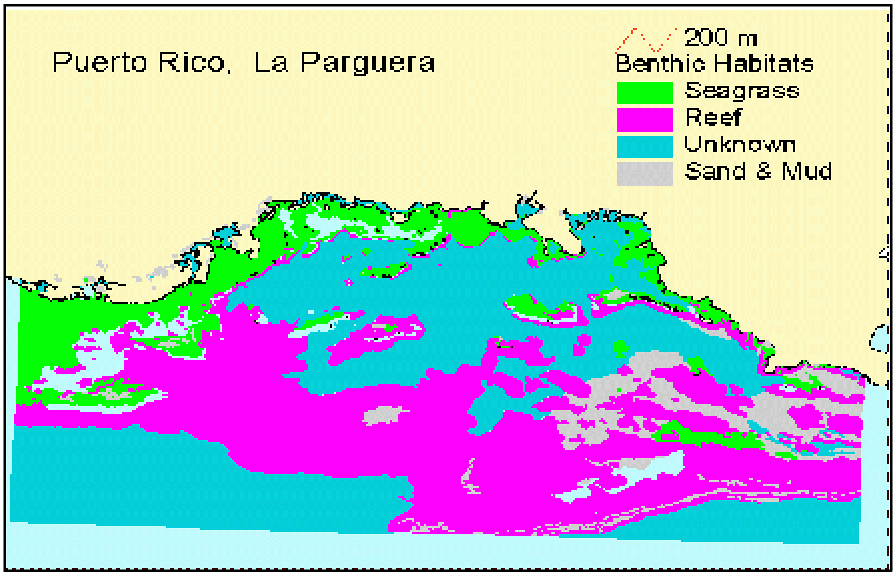

Figure 4. Dominant benthic habitats off La Parguera, Lajas, Puerto Rico.

Characterization of shallow benthic habitats has been completed recently (cooperators include University of the Virgin Islands, VIDPNR, U. S. Geological Survey, National Park Service, and NOAA; available from U. S. Department of Commerce, NOAA, National Ocean Service, Silver Spring, MD). Habitat categories have been combined to reflect system dominants such as coral reef, seagrass, macroalgae, and unknown or uninterpreted substrates (Figure 6). Coral and seagrass dominate the fishable area of St. Croix, while extensive algal plains are prominent in the reef systems of St. Thomas and St. John. Again, deeper waters are of unknown habitat type but they may not all be coral reefs. Much of the trap fishing effort is offshore and in waters deeper than those included in the mapping effort (B. Kojis, VIDPNR, St. Thomas, USVI, pers. comm.).

Gear Impacts

Traps may impact coralline habitat types during setting or hauling, while fishing, during storms, or if lost. When set or hauled, traps may physically damage hard and soft corals, sponges, seagrasses, and macroalgae. While in place, traps may flatten structural components of corals as well as plants, leading to injury and reduced growth or death. If traps are set in strings or lines, the connecting lines may abrade or shear structures surrounding them. Grapples used for retrieval of traps or trap lines potentially add another source of damage. Storms may cause damage by dragging traps and trap lines over the bottom. Lost traps could cause continuous habitat damage until they degrade.

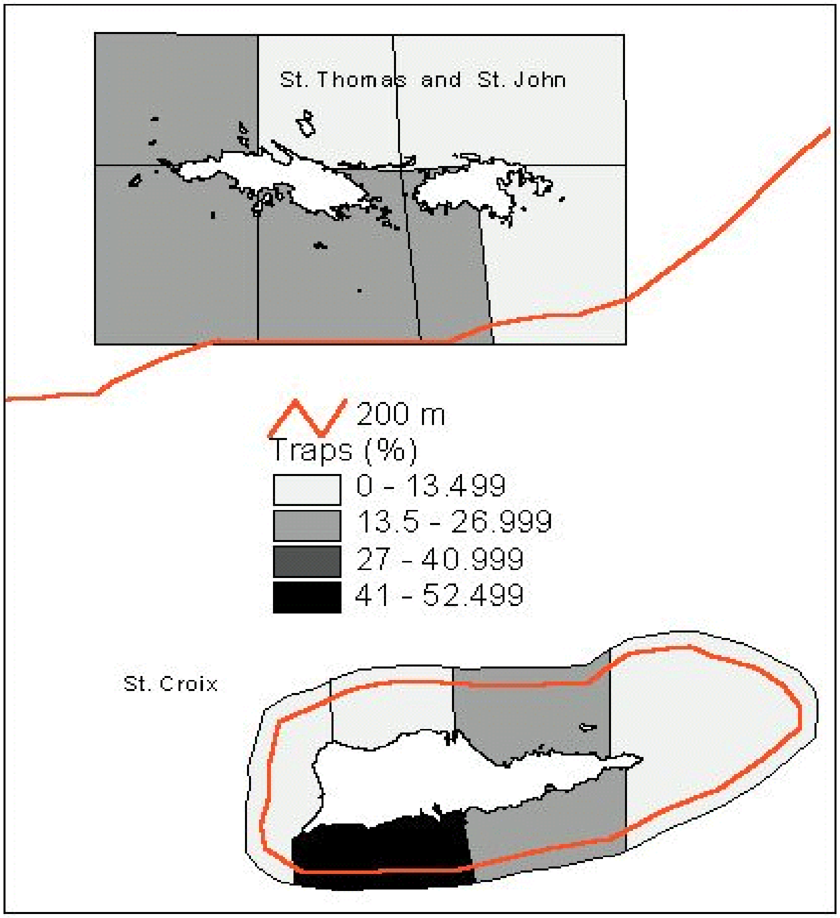

Figure 5. Proportional distribution of all traps fished in the U. S. Virgin Islands during 1998 (sum to 100% each for St. Croix and for St. Thomas + St. John).

Few studies have been conducted to assess the potential for trap-induced injuries to coralline habitats. One inshore study indicated that lobster traps were placed primarily on turtlegrass *Thalassia testudinum* habitats in Biscayne Bay, Florida (Ault et al. 1997). Traps were responsible for a 7% loss of turtlegrass cover after 1 week (typical soak time) and 26% cover after 1 month (simulating a lost trap). One of the more well-studied offshore areas is Lajas, southwestern Puerto Rico. Valdéz-Pizzini et al. (1997) and Jean-Baptiste (1999) examined the distribution of traps offLajas and found that the majority of traps were located over algal plains or sand substrates. Appeldoorn et al. (2000) noted that while 45 of 100 of traps examined in this area were placed in sand / mud habitats, another 44 were placed in hard bottom and reef habitats. Other studies have examined trap placement near St. Thomas and St. John, U. S. Virgin Islands. Quandt (1999) noted that 18 traps were almost evenly split between sand or rubble and reef around St. Thomas. Garrison et al. (in prep.) checked 295 traps, noting that the largest portion were set in algal plains around St. John but that relatively large numbers of traps were found in octocoral and hard coral substrates. Three studies have attempted to quantify damage to coralline habitats from trap fishing. Both Quandt (1999) and Appeldoorn et al. (2000) found the actual areas of damage to corals, sponges, and gorgonians was low (2-5%), but the proportions of colonies damaged was high (up to 50%). Eno et al. (2001) noted that lobster and crab traps in Great Britain bent and uprooted sea pens, bent but did not damage sea fans, and damaged some hard coral colonies.

HOW WE PROPOSE TO LEARN MORE

One aspect we have little knowledge of in most of the trap fishing areas is where the traps are actually placed in relation to the habitats under and adjoining them. In the near future, we will be mapping the distribution of trap effort in selected areas of the Florida Keys, Puerto Rico, and the U. S. Virgin Islands using small boat transects and GPS systems. We will compare these data to available benthic habitat maps in a GIS system, assessing seasonal and spatial variations in effort data collected by local partners with local knowledge (e.g., FMRI, VIDPNR, University of Puerto Rico). We will compare aerial transects versus boat transects of trap locations in an attempt to collect more synoptic trap distribution patterns. We will compare these data against fishery-dependent data to determine whether these alternative methods could enhance local fishery management.

There is a need to examine the underwater placement of a large number of traps using standard methods in all locations, in order to have a more synoptic determination of potential habitat damage. We intend to dive on hundreds of traps in each area to verify habitat placement and to quantify damage beneath and adjacent to traps. However, the process of diving on a large number of traps is limited by bottom time, especially if one has few divers and traps are fished beyond 40 m depths. We will develop underwater video techniques (using a remotely operated vehicle) for benthic assessment of habitat damage in deeper waters that are comparable to shallow water diver techniques used in Puerto Rico (Appeldoorn et al. 2000). We intend to compare diver and underwater video observations in both trapped and non-trapped locations.

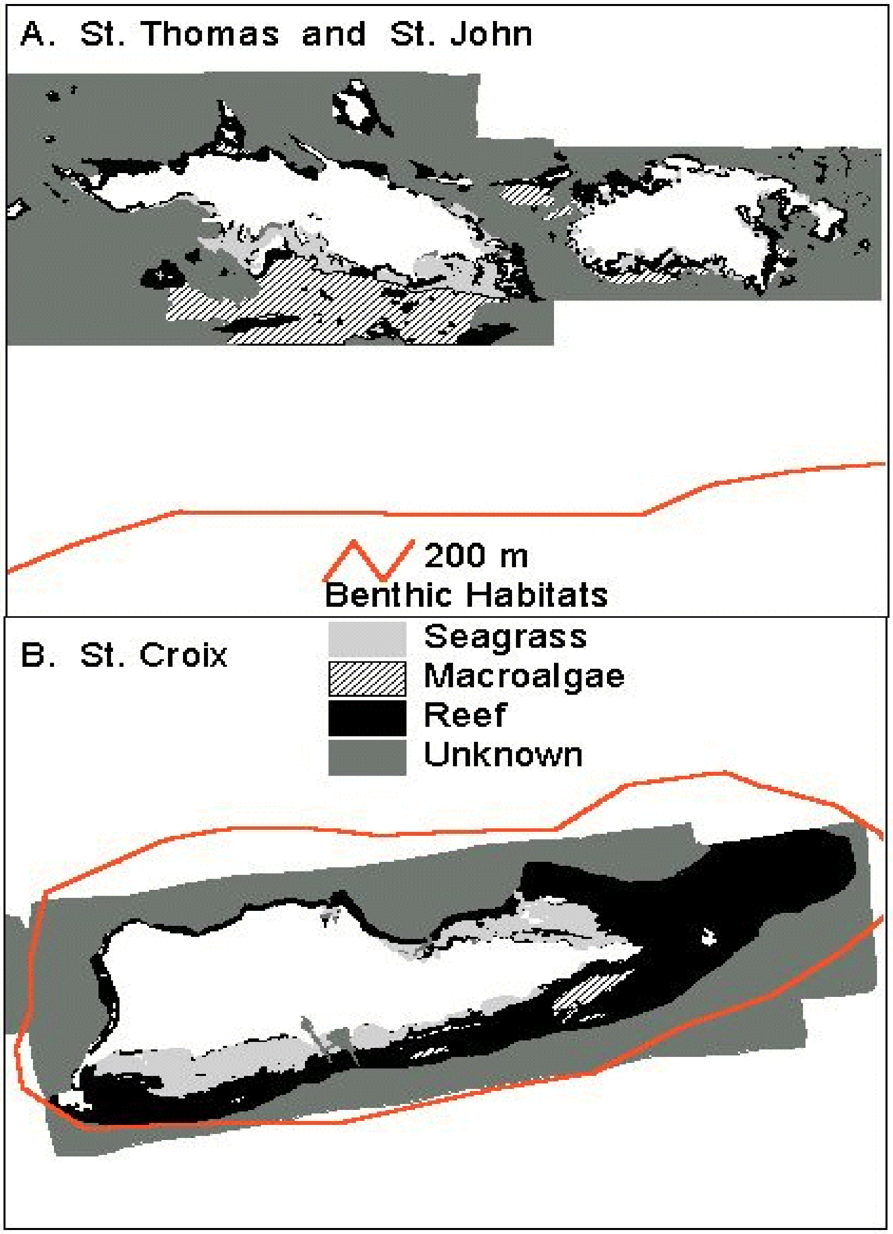

Figure 6. Dominant benthic habitats for the U. S. Virgin Islands.

Appeldoorn et al. (2000) noted that the process of trap hauling may inflict extra damage to the substrate. We will work with local fishers to study their trap fishing techniques, using underwater video to examine trap setting, trap hauling, grappling, and anchoring, in order to quantify and differentiate among habitat effects. Permanent locations for long term monitoring of habitat damage and recovery will be established in representative habitats with emphasis on marine reserve areas as controls. Trapping gear and techniques vary significantly in each of the three geographic locations, and inter-regional comparisons will allow identification of more habitat-friendly gear or techniques that can be recommended for fisher and management agency consideration.

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